AAAS Meeting, 12-16 February, 2004, Seattle, WA
http://www.aaas.org/meetings/index.html

Type: Speaker

Event: Integrated Microbiology: Beyond Genome Sequencing

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Abstract Title: Deinococcus radiodurans: Integrating Genomics and Microbiology

Abstract: Deinococcus radiodurans is one of the most radiation resistant organisms yet discovered. This non-pathogenic, obligate aerobic bacterium is best known for its ability to survive extremely high doses of acute ionizing radiation (10,000 Gy) without cell-killing. For comparison, 5 Gy is lethal to the average human, and 1,000 Gy can sterilize a culture of Escherichia coli. D. radiodurans is capable of growth under chronic radiation (60 Gy/hour) and resistant to other DNA damaging conditions including exposure to desiccation, UV light, and oxidizing agents. The genes and cellular pathways underlying the survival strategies of D. radiodurans are under investigation, and its resistance characteristics are being exploited in the development of bioremediation processes for cleanup of highly radioactive US Department of Energy waste sites. In particular, we aim to develop experimental models for understanding the reduction of metals coupled to organic compound oxidation in aerobic radionuclide-contaminated environments. The identity of the genetic systems underlying the repair processes in D. radiodurans remains unknown in spite of

detailed global cellular analyses including whole genome sequencing and annotation, and transcriptome and proteome profiling of cells recovering from high-dose irradiation. Following comparative genomic analysis of D. radiodurans, we analyzed transcriptome dynamics of D. radiodurans recovering from radiation using a whole genome microarray (www.esd.ornl.gov/facilities/genomics/functional_genomics.html). Collectively, these results have formed the basis for identifying novel genes involved in radiation resistance, and implicated the unusual metabolic configuration of D. radiodurans as an important contributor to the resistance phenotype. In the design of D. radiodurans for bioremediation, we have developed a strain that can completely mineralize (degrade to CO_2 and water) toluene and other toxic fuel hydrocarbons, and use energy derived from toluene degradation for cell biosynthesis, survival, and metal reduction under chronic radiation.